

note-book. The observations were made by Mr. Fowler (who was assisted by Mr. Coppen) on February 5 :—

“Made further observations of the nebula of Orion with 4-prism Steinheil spectroscope. First compared nebula spectrum with spectrum of spark between iron poles close to slit, the secondary collimator not being used at all.

“*Results.*—495 nebula line exactly coincident with iron line 4956·8. At the same time, the 500 nebula line was certainly less refrangible than the nitrogen lines.

“Next adjusted collimator and put hydrogen tube and iron spark successively in front of slit.

“*Results.*—3rd nebula line coincident with F line of hydrogen.

“495 line coincident with iron 4956·8.

“500 line less refrangible than nitrogen lines.

“500 line exactly coincident with magnesium fluting, whether the magnesium was burned behind the slit of collimator or at the centre of siderostat mirror.”

It will be seen that these observations entirely confirm those which I have already communicated to the Society, and also carry the work a step further in the determination of the actual wave-length of the nebula line near $\lambda 495$ by the siderostat and collimator method.

“Preliminary Note on Photographs of the Spectrum of the Nebula in Orion.” By J. NORMAN LOCKYER, F.R.S. Received and read February 13, 1890.

In other communications to the Society, I have shown that the chief nebula line coincides absolutely in position with the remnant of the fluting seen in the flame of burning magnesium near $\lambda 500$, with the highest dispersion we could command at South Kensington. Attempts have recently been made, therefore, with the 30-inch reflector at Westgate-on-Sea, to obtain photographs of the spectrum of the nebula, using magnesium as the term of comparison. The objects sought were, primarily, to determine whether there was a line in the nebula corresponding with one of the lines of the magnesium triplet about $\lambda 373$, and to obtain as complete a photographic record as possible of the spectrum between this triplet and $\lambda 500$. With this view, Mawson's instantaneous plates were used, these having been found to be fairly sensitive to the green. The exposures have been carried up to four hours, and five photographs have already been taken, some of them with shorter exposures than that named, in consequence of the sky becoming clouded or irregularities in the driving clock, which is not yet completely finished. One plate only was exposed for four hours, on February 11, but, unfortunately, in

VOL. XLVIII.

P

consequence of the high wind, the slit was covered for an unknown part of this time by the velvet used to keep out stray light, and this was not at once discovered, as the finder for directing the telescope is at the lower end of the reflector tube, away from the spectroscope. This photograph only shows three or four of the more prominent lines, but they are all sharply defined. The other photographs were taken on February 2, 8, 9, and 10, the last with an exposure of three hours.

As a collimator has not yet been fitted to the tube of the reflector, the exposure of the plate to the flame of burning magnesium was made by closing the mirror cover, and burning magnesium at its exact centre. One half of the slit was exposed to the nebula, and the other half to the magnesium.

Two prisms of 60° were employed. The part of the nebula photographed was the bright portion preceding the Trapezium. In some cases, in consequence of clock irregularities, the stars of the Trapezium have imprinted their spectra upon the plates, but these in no way interfere with the spectrum of the nebula, since a longish slit was used, and the spectra of the stars are narrow.

There is a remarkable and almost absolute similarity between the photographs obtained. The best one, taken on February 10, shows all the lines of the other photographs in addition to others, and this has therefore been selected for the determination of wave-lengths; it contains at least twenty-eight lines, about eight of them falling between F and G.

The principal lines are the three ordinarily seen in the visible spectrum, the lines of hydrogen at G, *h*, and H, and the strong line in the ultra-violet near $\lambda 373$. G is by far the strongest line in the spectrum. The wave-length of the least refrangible line on the photograph was taken as 5006.5, as determined at Kensington, and this, together with the hydrogen lines and the ultra-violet magnesium triplet in the comparison spectrum, formed the basis of the curve for determining the positions of the fainter lines.

The lines next in importance to those already mentioned are near wave-lengths 4470, 3890, and 3870. The first of these, the strongest between F and G, is probably the line observed by Dr. Copeland, and, as I have stated in a previous paper, is possibly Lorenzoni's *f* of the chromosphere spectrum. There are also two fairly obvious lines between F and 495.

Amongst the fainter lines, the most prominent are near $\lambda 4027$ and 4045, the former doubtless being the strong fine triplet seen in the flame spectrum of manganese.

Other still fainter lines are also shown, amongst which the most interesting are the flame lines of calcium near 3933 (K) and 4226, and lines near 4690 and 4735, which are probably the boundaries of

the compound carbon fluting. It seems, therefore, probable that all the fainter lines are either due to carbon or to low-temperature metallic lines.

It is a very striking fact that some of the chief lines are apparently coincident, although the statement is made with reserve, with the chief bright lines in P Cygni, a magnificent photograph of which I owe to the kindness of Professor Pickering; it is one of the Henry Draper Memorial photographs.

The wave-length of the line about $\lambda 373$ may, perhaps, even yet not be considered quite settled; but this much may be said, that, in those photographs in which the chief nebula line is sensibly coincident with the magnesium fluting, the ultra-violet line is very nearly, if not quite, coincident with the least refrangible member of the magnesium triplet ($\lambda 3730$). This, however, is somewhat uncertain, because of the over-exposure of the magnesium spectrum. It is certainly not coincident with either of the more refrangible lines of the triplet, as the measured distance between the two lines of the nebula is almost the same as that between the least refrangible line and the fluting near $\lambda 500$ of the magnesium spectrum.

The most satisfactory determination of the position of the ultra-violet line has been made by a comparison of the two photographs of February 10 and 11. The magnesium spectrum in the latter photograph is more clearly defined than in the former one, the slit being narrower, and the other instrumental conditions remaining the same.

The distance between the fluting near 500 and the least refrangible member of the triplet on the photograph of February 11 was found to be very slightly less than that between the two nebula lines on the photograph of February 10. According to these measures, the nebula line falls between the two magnesium lines at 3730 and 3724, about one-sixth of the distance between them from the former, giving its wave-length as nearly 3729. These measures, however, must only be regarded as preliminary.

A complete map is being prepared by Mr. Fowler, but, as it requires careful manipulation of the incident light for the detection of the more delicate lines, it is not yet completed. I have asked Mr. Fowler to take complete charge of this work, for the reason that the sensitiveness of my own eyes is somewhat impaired.

I have finally to express my great obligations to Mr. Fowler for the zeal and patience which he has displayed in taking the photographs. He is entirely responsible for those taken on February 2, 10, and 11, when I was away from Westgate.